forms of interferometer in which the interfering pencils are separated and then reunited after reflections at a series of plane mirrors is deduced. It is explained, further, that with such instruments the accuracy of measurement possible with a telescope or microscope can be greatly exceeded, and that, too, without serious loss of light.

The application of interference methods to various measurements forms the subject of the remaining lectures.

One of the features of the Edinburgh meeting of the British Association in 1892 was Michelson's paper on the application of interference methods to spectroscopic research read before Section A and printed in full among the reports.

Fizeau had years before explained the gradual disappearance and reappearance of Newton's rings when formed by sodium light between a flat surface and a lens of small curvature as the distance between the two is increased. It is due to the fact that the D line is double; the ring system seen, therefore, is a complex one produced by the superposition of the two systems due to each line separately. When the bright rings of the two systems coincide, the visibility of the rings is a maximum; as the distance between the lens and plate is increased, the bright rings of the first system overlap the dark rings of the second, the intensity of the field becomes uniform, and the rings cease to be visible.

Michelson defined the visibility of the ring system and showed how it depends on the distribution of light in the source; he then proceeded to measure experimentally the visibility of the rings formed by various spectrum lines, and from this to analyse the distribution of light in the lines. By a stroke of genius he utilised the defects of the ring system to advance our knowledge to a surprising extent. Lecture iv. contains a most interesting account of his work.

The chapters that follow are no less fascinating; thus the next lecture describes the measurements undertaken by Michelson at the Bureau International des Poids et Mesures at Sèvres to determine the relation between the wave-length of cadmium light and the standard metre; cadmium light was chosen because of the simplicity of the lines of its spectrum, and it was shown that in air at 15° C. and at normal pressure the number of waves in a metre is for the red ray of cadmium 1553163·5, for the green ray 1966249·7, and for the blue 2083372·1. The absolute accuracy of these results is said to be about one part in two millions, the relative accuracy about one part in twenty millions.

In Lecture vii., application of interference methods to astronomy, it is shown how an examination of the visibility curve of a star enables the observer to detect double stars which are far too close to be resolved by any telescope, while the last lecture, on the ether, deals with a problem which is yet unsolved, the theory of aberration.

The aberration constant, the ratio of the velocity of the earth to that of light, is a quantity of the order 1/10000, and its accurate measurement had proved no easy task. Michelson, with the view of solving the question whether the earth is at rest or in motion relative to the ether at its surface, undertook a measurement which involved the square of this tiny quantity, or one part in one hundred millions, and carried it out successfully. The result of the experiment was to show that this relative motion, if it exists at all, must be extremely small, and that the ordinary explanation of aberration, which assumes that the ether remains at rest while the earth moves through it without disturbing it, is untenable. The only solution of the difficulty yet offered is that due to Lorentz and Fitzgerald, who pointed out, independently, that the motion of a body through the ether might, on certain assumptions as to the connection between ether and matter, cause the body to contract in the direction of motion, and that this contraction would depend on the square of the aberration constant, so that its effect might compensate for the effect looked for by Michelson.

In his first lecture the author apologises for using, as illustrations of his subject, his own researches.

> "I do this," he says, "because I believe I shall be much more likely to interest you by telling what I know than by repeating what someone else knows."

Prof. Michelson has earned our thanks for putting some of his knowledge into so attractive a form; he will perhaps forgive us if, in closing, we express the wish that he will tell us more of what he knows.

R. T. G.

ALL ABOUT CATS.

The Book of the Cat. By Miss F. Simpson. Pp. viii+380; illustrated. (London: Cassell and Co., Ltd., 1903.) Price 15*s.* net.

THE "cult of the cat" has of late years increased to such an enormous extent that there can be no doubt as to the need for a thoroughly trustworthy and exhaustive account of the various breeds kept in this country, together with notices of those of other lands. Of this favourable opportunity Miss Simpson has taken full advantage in the handsome and beautifully illustrated volume before us, the exceedingly low price of which places it within reach of fanciers in all ranks of life. In addition to the description of the various breeds kept in this country, the author has also given chapters on the feeding, housing, and general treatment of cats (derived from her own extensive experience), as well as on the management of cat-shows; while other chapters by various specialists are devoted to foreign breeds, the cat's place in nature, and the diseases of cats and their treatment. The book is therefore a compendium of all that relates to domesticated cats, and it may be almost said that it contains practically all that is worth knowing about these animals.

Perhaps the least satisfactory portion of the book, so far as Miss Simpson is concerned, is to be found in the opening lines of the first chapter, where we find the statement that the origin of the cat has long puzzled the learned, and is still a zoological mystery. Neither does the second sentence—"Historians tell us that the feline race came into existence about the same

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time as the horse"—tend in any way to mend matters. Moreover, when we turn to the chapter on some foreign cats, by Mr. H. C. Brooke, we find it stated, although somewhat guardedly, that the Egyptian cat is the probable ancestor of our domesticated breeds. There does not, therefore, seem to be complete accord in this respect between the two authors, and we venture to suggest that, although the pedigree of the original British breed of cat cannot be fully traced, the term "mystery" is scarcely appropriate to the real facts of the case. In this connection mention may be made of Mr. Brooke's error in referring (p. 297) to the European and Egyptian wild cats as "varieties" instead of "species." It is perfectly true that the mistake, in analogous cases, is very frequently made by amateur zoologists, but it is nevertheless quite inexcusable.

Passing over the chapters devoted to the housing and exhibition of cats, our attention may be directed to what Miss Simpson has to say with regard to the various breeds kept in this country. The first group taken into consideration is that of the long-haired or Persian breeds, of which quite a number of different strains, chiefly or entirely distinguished by colour, are recognised by fanciers. The author is of opinion that no satisfactory distinction can be drawn between Angora and Persian cats, and in this she is doubtless right. No reference is, however, made to the opinion current among zoologists that the Persians very probably trace their origin to the long-haired Pallas's cat (*Felis manul*) of Central Asia, which, with the exception of the tail and limbs, is a nearly uniformly coloured species. Neither is enough made of the fact that all imported Persians appear to be uniformly coloured, although a quotation from Mr. Harrison Weir to this effect is given. If this be really the case, there can be no doubt that all Persians with "tabby" and "tortoise-shell" markings are due to a cross between the pure breed and European cats. Strong confirmation of this is afforded by a statement of the author to the effect that so-called orange Persians tend to lose their markings and become uniformly coloured.

Under the heading of Manx cats the author alludes to the current belief that these are due to a cross between a cat and a rabbit! A whole chapter is devoted to the beautiful Siamese cat, although no reference is made to its possible origin from the bay cat (*F. badia*). To the author's account of ordinary short-haired cats we need not refer, and the remaining space at our disposal must be devoted to foreign cats (other than those kept in this country). Mr. Brooke, in chapter xxvi., has been fortunate in securing some very interesting photographs, notably those of the Burmese and Abyssinian breeds, the latter of which is also represented in a coloured plate, together with an Indian cat. Most remarkable of all is, however, the photograph of hairless New Mexican cats, now said to be all but, if not quite, extinct.

Although the book might have been improved if the proofs had been submitted to a zoologist, there can be little hesitation in pronouncing it a decided success, and indispensable to every student and breeder of cats.

R. L.

AMERICAN RAILWAYS.

American Railways. By Edwin A. Pratt. Pp. viii+309. (London: Macmillan and Co., Ltd., 1903.) Price 3*s.* 6*d.* net.

AS it appears to be the fashion just now to look upon British railroad management as antiquated, and its methods effete, it is interesting to study a book dealing with American practice, as its adoption in this country is looked upon by some as the only salvation of British railways from a dividend earning point of view.

The volume before us deals with the general question in a fair and open manner. Mr. Pratt evidently went to the States with the intention of seeing as much as possible, and comparing what he did see with home practice; he gives us in his book a very readable account of the result.

The big waggon question is, of course, interesting, and we read that twenty-five years ago the average freight box waggon in the United States had a capacity ranging from 16,000 lb. to 24,000 lb. Then, in 1881, the 40,000 lb. waggon was introduced, this being followed in 1885 by the 60,000 lb. waggon. After this, in 1898, a waggon, though no larger than its predecessors, was so constructed as to have a capacity of 80,000 lb., and to-day waggons are being extensively used with a capacity of 100,000 lb. This continual increase in waggon capacity is well illustrated by means of tables. The dead weight is gradually being reduced, and in the case of pressed steel waggons the proportion of paying weight to the total weight of the car when loaded is 73 per cent., and it is interesting to know that waggons of this type are being gradually introduced into this country, the most satisfactory being those designed and made by the Leeds Forge Company.

With the rapid increase in the weight of trains hauled came the heavier and more powerful locomotive, and it is here where the American locomotive engineer has the advantage of his British brother, it being possible for the American engine to be both higher and wider than the British engine, thus materially increasing its capacity.

We read that the majority of American officials with whom the author discussed the big waggon question did not care to commit themselves to any recommendation of the use of such large waggons in Great Britain. The nearest approach is the American type of enlarged freight waggon for the transport of coal from the collieries to the sea, and these are now being successfully used by the North-Eastern Railway.

An important conversation with a prominent official is reported on the general question of handling of traffic in the two countries. He said, ours is wholesale business, yours is retail. We get bigger lots than you do, and we can handle them to better advantage; but in regard to general merchandise your arrangements are far better than ours, &c. It is evident, therefore, that the conditions are so very different that the mere adoption of American methods *en bloc* is not sufficient in itself. No doubt there are many practices which can be assimilated with advantage, and these can only be discovered and thought out by sending

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